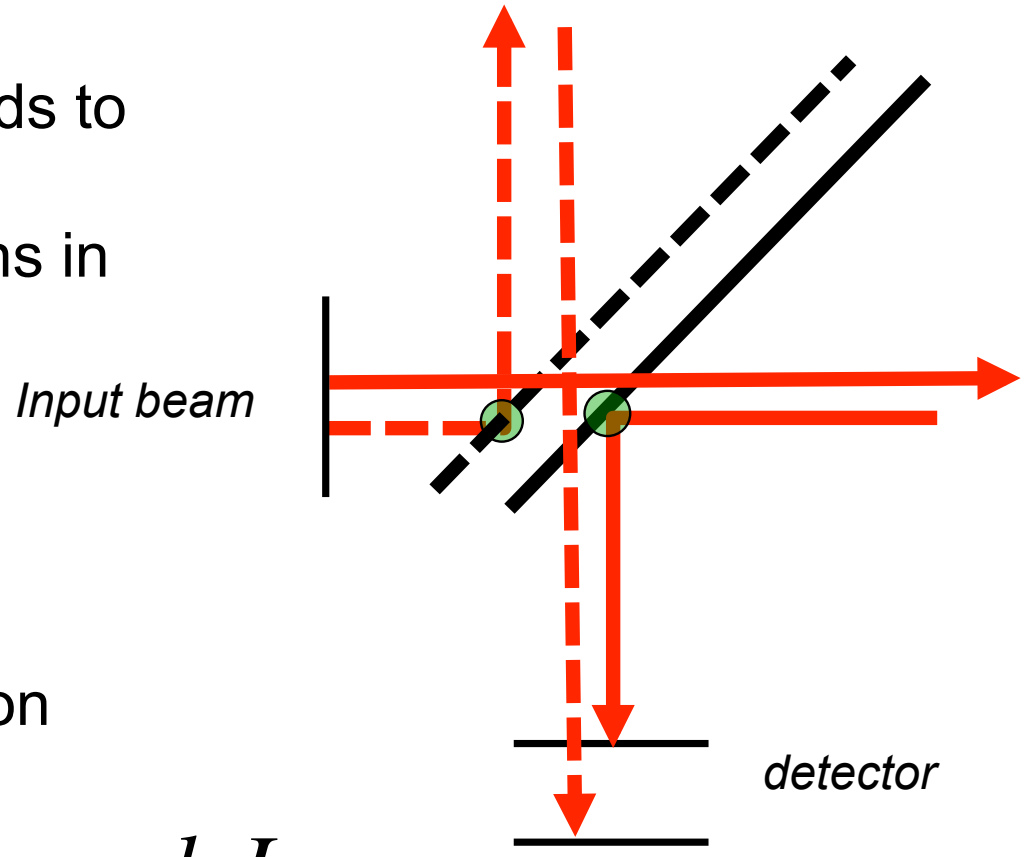
Holographic noise in a Michelson interferometer

Holographic "jitter" in beamsplitter position leads to fluctuations in measured phase between reflections in different directions



Range of jitter depends on arm length:

$$\Delta x_1 \Delta x_2 \approx l_P L$$

this is a new effect predicted with no parameters

Interferometers as Planckian clocks

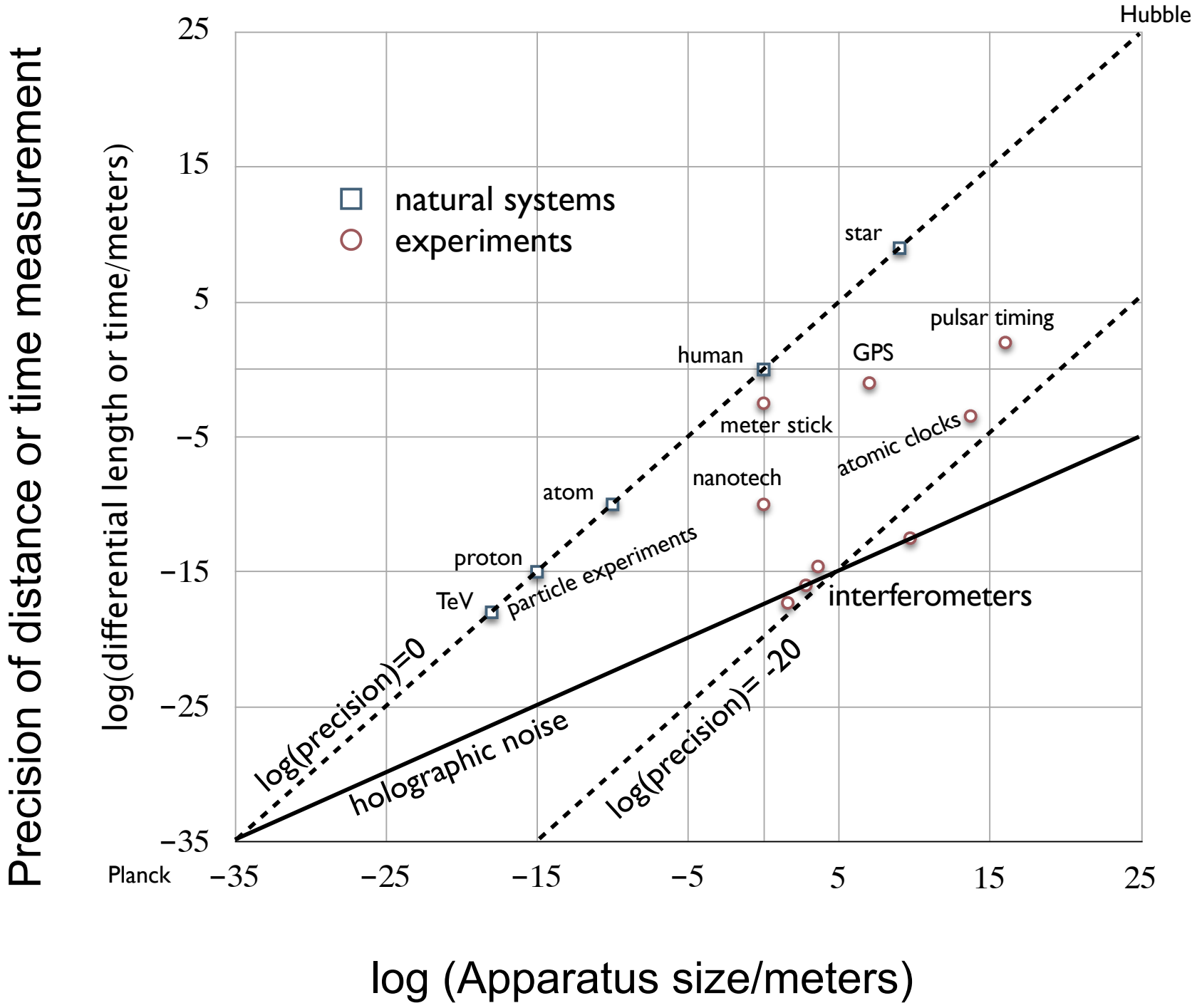
Over short (~ size of apparatus ~ microsecond) time intervals, interferometers can reach Planck precision (~ attometer jitter)

Predicted noise in *differential* frequency between two directions:

$$\frac{\Delta\nu(\tau)}{\nu} \approx \Delta t(\tau)/\tau = \sqrt{\frac{2 \times 5.39 \times 10^{-44}\mathrm{sec}}{\pi\tau}} = 1.8 \times 10^{-22}/\sqrt{\tau/\mathrm{sec}}$$

Compare to best atomic clocks (over longer times):

$$\frac{\Delta\nu(\tau)}{\nu} = 2.8 \times 10^{-15}/\sqrt{\tau/\mathrm{sec}}$$


Precision of distance or time measurement
log(differential length or time/meters)
log (Apparatus size/meters)
Hubble
Planck
25
15
5
−5
−15
−25
−35
−35
−25
−15
−5
5
15
25
natural systems
experiments
star
human
pulsar timing
GPS
meter stick
atomic clocks
nanotech
atom
proton
TeV
particle experiments
interferometers
log(precision)=0
holographic noise
log(precision)= -20